



VERIFICATION OF A TRANSLATION

I, Tetsuo AKIYOSHI, of 5th Floor, Shintoshicenter Bldg., 24-1, Tsurumaki 1-chome, Tama-shi, Tokyo 206-0034 Japan, declare that I am well acquainted with both the Japanese and English languages, and that the attached is an accurate translation, to the best of my knowledge and ability, of the Japanese language Patent Application No. JP2003-012312 filed on January 21, 2003.

Signature

A handwritten signature in black ink, appearing to read "Tetsuo Akiyoshi", written over a horizontal line.

Date

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[TITLE OF THE INVENTION]

TEST APPARATUS, MOBILE TERMINAL APPARATUS AND TEST  
METHOD

5 [SCOPE OF CLAIMS FOR PATENT]

[Claim 1] A test apparatus comprising:

a measurement signal generating section that  
generates a measurement signal for use in carrying out  
a radio transmission characteristics test on a mobile  
10 terminal apparatus to transmit to the mobile terminal  
apparatus;

a measurement signal judging section that carries  
out radio characteristics evaluation based on the  
measurement signal which is transmitted in loopback from  
15 the mobile terminal apparatus and received in the test  
apparatus; and

a control section that carries out control for  
suspending transmission of a signal transmitted  
intermittently from the mobile terminal apparatus by an  
20 RLC function in communicating the measurement signal  
with the mobile terminal apparatus.

[Claim 2] The test apparatus according to claim 1,  
wherein the control section controls the RLC function  
of the mobile terminal apparatus by radio connection via  
25 a radio interface.

[Claim 3] The test apparatus according to claim 1,  
wherein the control section controls the RLC function  
of the mobile terminal apparatus by wired connection via

an external interface.

[Claim 4] A mobile terminal apparatus which connects to the test apparatus according to any one of claims 1 to 3, and suspends transmission of the signal transmitted intermittently by the RLC function in transmitting the measurement signal for use in carrying out the radio transmission characteristics test to the test apparatus.

[Claim 5] A mobile terminal apparatus comprising:  
10 a section that receives a signal transmitted from a test apparatus and transmits the signal in loopback; and

a control section that suspends transmission of a signal transmitted intermittently by an RLC function in carrying out a radio transmission characteristics test.

[Claim 6] The mobile terminal apparatus according to claim 5, wherein according to an instruction from an external apparatus, the control section suspends transmission of the signal transmitted intermittently  
20 by the RLC function.

[Claim 7] The mobile terminal apparatus according to claim 5, further comprising:

an operation section that conveys an instruction due to operation of a user to the control section,  
25 wherein according to an instruction from the operation section, the control section suspends transmission of the signal transmitted intermittently by the RLC

function.

[Claim 8] A test method on a mobile terminal apparatus in a CDMA mobile communication system, comprising:

5       suspending transmission of a signal transmitted intermittently by an RLC function of the mobile terminal apparatus; and

          carrying out a radio transmission characteristic test.

10       [Claim 9] A test method in a mobile terminal apparatus in a CDMA mobile communication system and a test apparatus that is connected to the mobile terminal apparatus, comprising:

          transmitting and receiving a layer 3 signal to  
15       implement radio connection over CDMA radio interface;

          suspending transmission of a signal transmitted intermittently by an RLC function of the mobile terminal apparatus; and

          transmitting and receiving a measurement signal to  
20       carry out a radio transmission characteristic test.

[Claim 10] A test method in a mobile terminal apparatus in a CDMA mobile communication system and a test apparatus that is connected to the mobile terminal apparatus, comprising:

25       setting a CDMA radio interface;

          setting conditions of layers 1 and 2 to transmit and receive a measurement signal;

setting a condition for carrying out loopback processing;

suspending transmission of a signal transmitted intermittently by an RLC function of the mobile terminal  
5 apparatus;

carrying out in the test apparatus the radio transmission characteristic test on the mobile terminal apparatus;

releasing the loopback processing; and

10 releasing the CDMA radio interface.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field of the Invention]

The present invention relates to a test apparatus,  
15 mobile terminal apparatus and test method to conduct radio transmission characteristics test and radio function test on the mobile terminal apparatus in a CDMA mobile communication system.

[0002]

20 [Prior Art]

A mobile communication terminal in a CDMA mobile communication system has a function of transmitting and receiving signaling signals and a function of transmitting and receiving user information, and the  
25 transmission power is determined depending on the present or absence of each of the two kinds of signals.

[0003]

In a radio transmission characteristic test in layer 1 on a mobile terminal apparatus, a test apparatus

transmits a signal to be measured (hereinafter referred to as a "measurement signal" ) as user information to the mobile terminal apparatus, and the mobile terminal apparatus transmits the measurement signal as the user information to the test apparatus using the loopback function.

[0004]

In the radio transmission characteristic test, it is preferable that the transmission power is constant. However, since signaling signals are transmitted intermittently, some measures are required to keep transmission power constant.

[0005]

In a conventional test method, a communication terminal apparatus transmits an additional signal (hereinafter referred to as "dummy transmission" ) for a period during which a signaling signal is not transmitted, and thereby keeping transmission power constant.

[0006]

[Patent document 1]

Unexamined Japanese Patent Publication 2000-22780

[Patent document 2]

Unexamined Japanese Patent Publication 2000-258663

[0007]

[Problem to be Solved by the Invention]

However, performing dummy transmission is an unnecessary function except the radio transmission characteristic test, and the conventional test method has a problem that a mobile terminal apparatus must be

provided with the function only required for the radio transmission characteristic test.

[0008]

It is an object of the present invention to provide  
5 a test apparatus, mobile terminal apparatus and test method that enable the radio transmission characteristic test to be carried out with constant transmission power without providing the mobile terminal apparatus with the function only required for the radio transmission  
10 characteristic test.

[0009]

[Means for Solving the Problems]

A test apparatus of the present invention adopts a configuration including a measurement signal  
15 generating section that generates a measurement signal for use in carrying out a radio transmission characteristics test on a mobile terminal apparatus to transmit to the mobile terminal apparatus; a measurement signal judging section that carries out radio  
20 characteristics evaluation based on the measurement signal which is transmitted in loopback from the mobile terminal apparatus and received in the test apparatus; and a control section that carries out control for suspending transmission of a signal transmitted  
25 intermittently from the mobile terminal apparatus by an RLC function in communicating the measurement signal with the mobile terminal apparatus.

[0010]

The control section in the test apparatus of the



present invention adopts a configuration that controls the RLC function of the mobile terminal apparatus by radio connection via a radio interface.

[0011]

5           The control section in the test apparatus of the present invention adopts a configuration that controls the RLC function of the mobile terminal apparatus by wired connection via an external interface.

[0012]

10           A mobile terminal apparatus of the present invention adopts a configuration which connects to any one of the above test apparatuses, and suspends transmission of the signal transmitted intermittently by the RLC function in transmitting the measurement  
15 signal for use in carrying out the radio transmission characteristics test to the test apparatus.

[0013]

          A mobile terminal apparatus of the present invention adopts a configuration including a section  
20 that receives a signal transmitted from a test apparatus and transmits the signal in loopback; and a control section that suspends transmission of a signal transmitted intermittently by an RLC function in carrying out a radio transmission characteristics test.

25 [0014]

          The control section of the mobile terminal apparatus of the present invention adopts a configuration that suspends transmission of the signal transmitted intermittently by the RLC function according

to an instruction from an external apparatus.

[0015]

The mobile terminal apparatus of the present invention adopts a configuration further including an operation section that conveys an instruction due to  
5 operation of a user to the control section, wherein according to an instruction from the operation section, the control section suspends transmission of the signal transmitted intermittently by the RLC function.

10 [0016]

By these configurations, since it is possible to suspend transmission of the signal transmitted intermittently by the RLC function in carrying out a radio transmission characteristic test, the radio  
15 transmission characteristics test can be carried out with constant transmission power without providing the mobile terminal apparatus with a function only required for the radio transmission characteristics test.

[0017]

20 A test method of the present invention is a test method on a mobile terminal apparatus in a CDMA mobile communication system and adopts a method including suspending transmission of a signal transmitted intermittently by an RLC function of the mobile terminal  
25 apparatus; and carrying out a radio transmission characteristic test.

[0018]

A test method of the present invention in a mobile

terminal apparatus in a CDMA mobile communication system and a test apparatus that is connected to the mobile terminal apparatus adopts a method including transmitting and receiving a layer 3 signal to implement  
5 radio connection over CDMA radio interface; suspending transmission of a signal transmitted intermittently by an RLC function of the mobile terminal apparatus; and transmitting and receiving a measurement signal to carry out a radio transmission characteristic test.

10 [0019]

A test method of the present invention in a mobile terminal apparatus in a CDMA mobile communication system and a test apparatus that is connected to the mobile terminal apparatus, adopts a method including setting  
15 a CDMA radio interface; setting conditions of layers 1 and 2 to transmit and receive a measurement signal; setting a condition for carrying out loopback processing; suspending transmission of a signal transmitted intermittently by an RLC function of the  
20 mobile terminal apparatus; carrying out in the test apparatus the radio transmission characteristic test on the mobile terminal apparatus; releasing the loopback processing; and releasing the CDMA radio interface.

[0020]

25 By these configurations, since it is possible to suspend transmission of the signal transmitted intermittently by the RLC function in carrying out a radio

transmission characteristic test, the radio transmission characteristics test can be carried out with constant transmission power without providing the mobile terminal apparatus with a function only required for the radio transmission characteristics test.

[0021]

[Embodiment of the Invention]

The inventor of the present invention noted that a signaling signal is unnecessary in a radio transmission characteristic test, and has reached the present invention. In other words, it is a subject matter of the present invention that a test apparatus judges a type of test, and in the radio transmission characteristic test, carries out control for suspending a mobile terminal apparatus from transmitting a signaling signal.

[0022]

An embodiment of the present invention will be described below with reference to accompanying drawings.

[0023]

(Embodiment)

FIG.1 is a block diagram illustrating a configuration of a test apparatus and mobile terminal apparatus according to one embodiment of the present invention.

[0024]

Test apparatus 100 in FIG.1 is primarily comprised of protocol processing section 101, RLC (Radio Link Control) section 102, MAC (Media Access Control) section 103, layer 1 transmission section 104, layer 1 reception

section 105, measurement signal generating section 106, PDCP (Packet Data Convergence Protocol) section 107, measurement signal judging section 108, mobile terminal RLC control section 109, and control section 110 that  
5 controls the above-mentioned sections.  
[0025]

Mobile terminal apparatus 150 in FIG.1 is primarily comprised of protocol processing section 151, RLC section 152, MAC section 153, layer 1 transmission  
10 section 154, layer 1 reception section 155, loopback section 156, PDCP section 157, external interface 158, and control section 159 that controls the above-mentioned sections.  
[0026]

15 Transmission power measuring apparatus 200 measures the power of a signal transmitted from a mobile communication terminal apparatus to perform radio transmission characteristic evaluation.  
[0027]

20 In starting the test, a signal for instructing a test item is input to control section 110 in test apparatus 100 from outside.  
[0028]

When the test item is of radio transmission  
25 characteristic test, test apparatus 100 transmits a layer 3 signal to establish radio connection with mobile terminal apparatus 150 by CDMA radio interface, and further transmits a measurement signal.  
[0029]

The layer 3 signals are communicated between protocol processing section 101 in test apparatus 100 communicates layer 3 and protocol processing section 151 in mobile terminal apparatus 150.

5 [0030]

Specifically, a layer 3 signal generated in protocol processing section 101 is transmitted over the CDMA radio interface via RLC section 102, MAC section 103 and layer 1 transmission section 104, and is received  
10 in protocol processing section 151 via layer 1 reception section 155, MAC section 153 and RLC section 152. Further, a layer 3 signal generated in protocol processing section 151 is transmitted over the CDMA radio interface via RLC section 152, MAC section 153 and layer  
15 1 transmission section 154, and is received in protocol processing section 101 via layer 1 reception section 105, MAC section 103 and RLC section 102.

[0031]

In transmitting the layer 3 signal, mobile terminal  
20 RLC control section 109 notifies RLC section 152 of suspension of periodical automatic transmission of STATUS\_PDU (signaling signal) that is one of RLC functions.

[0032]

25 The layer 3 signals are communicated between protocol processing sections 101 and 151, whereby the CDMA radio interface is set (adjustments on communication content, communication rate, etc. on layer

1).

[0033]

Next, a measurement signal for the radio transmission characteristic test is communicated between measurement target signal generating section 106 and measurement signal judging section 108 in test apparatus 100 and loopback section 156 in mobile terminal apparatus 150. At this point, transmission power measuring apparatus 200 receives a notification indicating that the test condition is prepared from control section 110 in test apparatus 100, and starts measuring the power.

[0034]

Specifically, a measurement signal generated in measurement signal generating section 106 is transmitted over the CDMA radio interface via PDCP section 107, RLC section 102, MAC section 103 and layer 1 transmission section 104, and is received in loopback section 156 via layer 1 reception section 155, MAC section 153, RLC section 152 and PDCP section 157. Then, the measurement signal received in loopback section 156 is transmitted in loopback according to a predetermined loopback rule specified in advance by loopback function (hereinafter, the processing in loopback section 156 is referred to as "loopback processing"). The measurement signal transmitted from loopback section 156 is transmitted over the CDMA radio interface via PDCP section 157, RLC section 152, MAC section 153 and layer 1 transmission

section 154, and is received in measurement signal judging section 108 via layer 1 reception section 105, MAC section 103, RLC section 102 and PDCP section 107. Measurement target signal judging section 108 performs  
5 radio characteristics evaluation based on the received measurement signal. The measurement signal transmitted from layer 1 transmission section 154 over the CDMA radio interface is received in transmission power measuring apparatus 200. Transmission power measuring apparatus  
10 200 performs radio transmission characteristics evaluation based on the received measurement signal.  
[0035]

At this point, in the loopback processing, RLC section 152 suspends transmission of a signaling signal  
15 based on the notification from mobile terminal RLC control section 109, and transmits only the measurement signal. As a result, uplink transmission power is kept constant.  
[0036]

20 Among methods for notifying RLC section 152 of suspension of transmission of a signaling signal are, the following method can be considered. For example, (1) a method where mobile terminal RLC control section 109 transmits a control signal to protocol processing  
25 section 151 via protocol processing section 101, RLC section 102, MAC section 103, layer 1 transmission section 104, layer 1 reception section 155, MAC section 153 and RLC section 152, and protocol processing section



151 notifies RLC section 152 and (2) another method where mobile terminal RLC control section 109 transmits a control signal to control section 159 via external interface 158,, and control section 159 notifies RLC  
5 section 152.

[0037]

In addition, it may be possible to suspend transmission of a signaling signal in RLC section 152 in advance before starting the test. In this case, as  
10 shown in FIG.2, the following methods can be considered. For example, (3) a method where external control apparatus 300 is connected with mobile terminal apparatus 150, transmits a control signal to control section 159 via external interface 158, and control  
15 section 159 notifies RLC section 152, and another method (4) where mobile terminal apparatus 150 is provided with operation section 160 that conveys an instruction due to operation of a user to control section 159, operation section 160 transmits a control signal to control section  
20 159, and control section 159 notifies RLC section 152.  
[0038]

Thus, in this embodiment, a test item is judged, and in the radio transmission characteristics test, transmission of a signaling signal is suspended in RLC  
25 section 152 in mobile terminal apparatus 150, thus keeping the uplink transmission power constant.  
[0039]

In addition, during the test, control sections 110

and 159 control sections in respective apparatuses.

[0040]

Referring to the sequence diagram in FIG.3, communication procedures will be next described for  
5 radio transmission characteristics test on the mobile terminal apparatus carried out by the test apparatus according to this embodiment.

[0041]

In step 0, the test apparatus receives a  
10 notification of a test item and determines that the radio transmission characteristics test is selected. In step 1, the test apparatus transmits a signal of reception indicative of start of the test to the mobile terminal apparatus. In step 2, upon receiving the signal, the  
15 mobile terminal apparatus transmits a signal for requesting to start radio connection over CDMA radio interface to the test apparatus. Then, in step 3, the test apparatus transmits a signal for requesting to set the CDMA radio interface to the mobile terminal apparatus.  
20 In step 4, based on the signal, the mobile terminal apparatus carries out the setting, and transmits a signal for reporting completion of setting of the CDMA radio interface. Then, in step 5, the mobile terminal apparatus transmits a response signal to the reception  
25 in step 1.

[0042]

It is a feature of the present invention that in step 3 suspension is set of periodical automatic

transmission of STATUS\_PDU (signaling signal) from the mobile terminal apparatus.

[0043]

Next, in step 6, the test apparatus transmits a  
5 signal for requesting to eliminate a layer 3 signal that is not required as a mode of the test to the mobile terminal apparatus. In step 7, based on the signal, the mobile terminal apparatus eliminates the layer 3 signal and reports completion of the elimination to the test  
10 apparatus.

[0044]

In step 8, the test apparatus transmits to the mobile terminal apparatus a signal for requesting for setting of conditions of layers 1 and 2 to transmit a  
15 measurement signal. In step 9, based on the signal, the mobile terminal apparatus carries out the setting of condition of layers 1 and 2, and transmits a signal for reporting completion of the setting to the test apparatus.

20 [0045]

Next, in step 10, the test apparatus transmits a signal for requesting for setting of condition to perform the loopback processing to loopback section 156 in the mobile terminal apparatus. In step 11, based on the  
25 signal, the mobile terminal apparatus carries out the setting of condition of the loopback processing, and transmits a signal for reporting completion of the setting to the test apparatus.

[0046]

After that, the test apparatus carries out the radio transmission characteristics test on the mobile terminal apparatus. At this point, since transmission of a signaling signal is suspended in the loopback processing, the uplink transmission power is kept constant.

[0047]

After finishing the test, in step 12, the test apparatus transmits a signal for releasing the loopback processing to loopback section 156 in the mobile terminal apparatus. In step 13, based on the signal, the mobile terminal apparatus releases the loopback processing, and reports a signal for completion of the release to the test apparatus.

[0048]

Finally, in step 14, the test apparatus transmits a signal for releasing the CDMA radio interface to the mobile terminal apparatus. In step 15, based on the signal, the mobile terminal apparatus releases the CDMA radio interface, and reports a signal for completion of the release to the test apparatus.

[0049]

According to the above-mentioned communication procedures, the radio transmission characteristics test on the mobile terminal apparatus is completed that is carried out by the test apparatus according to the present invention.

[0050]

[Effects of the Invention]

As is apparent from the foregoing, according to the present invention, when a test item is of the radio transmission characteristics test, since it is possible to suspend transmission of a signaling signal in a mobile terminal apparatus, it is possible to carry out the radio transmission characteristics test with constant transmission power without providing the mobile terminal apparatus with a function only required for the radio transmission characteristics test.

10 [BRIEF DESCRIPTION OF THE DRAWINGS]  
[FIG.1]

A block diagram illustrating a configuration of a test apparatus and mobile terminal apparatus according to one embodiment of the present invention.

15 [FIG.2]

A block diagram illustrating another configuration of a test apparatus and mobile terminal apparatus according to the above embodiment.

[FIG.3]

20 A sequence diagram illustrating communication procedures for a radio transmission characteristic test on the mobile terminal apparatus carried out by the test apparatus according to the above embodiment.

[Description of the Symbols]

25 100 TEST APPARATUS

101, 151 PROTOCOL PROCESSING SECTION

102, 152 RLC SECTION

103, 153 MAC SECTION

104, 154 LAYER 1 TRANSMISSION SECTION

30 105, 155 LAYER 1 RECEPTION SECTION

106 MEASUREMENT SIGNAL GENERATING SECTION  
107, 157 PDCP SECTION  
108 MEASUREMENT SIGNAL JUDGING SECTION  
109 MOBILE TERMINAL RLC CONTROL SECTION  
5 110, 159 CONTROL SECTION  
150 MOBILE TERMINAL APPARATUS  
156 LOOPBACK SECTION  
158 EXTERNAL INTERFACE  
160 OPERATION SECTION  
10 200 TRANSMISSION POWER MEASURING APPARATUS  
300 EXTERNAL CONTROL APPARATUS

[NAME OF DOCUMENT] ABSTRACT  
[ABSTRACT]

[Object] To carry out a radio transmission characteristic test with constant transmission power  
5 without providing a mobile terminal apparatus with a function only required for the radio transmission characteristic test.

[Overcoming Means] Test apparatus 100 judges a test item, and when carrying out a radio transmission  
10 characteristics test, communicates layer 3 signals with mobile terminal apparatus 150 to implement radio connection over CDMA radio interface and transmit a measurement signal. In transmitting the measurement signal, mobile terminal RLC control section 109 notifies  
15 RLC section 152 of suspension of transmission of a signaling signal, and based on the notification, RLC section 152 suspends transmission of a signaling signal and transmits only the measurement signal.

[Selected Drawing] FIG.1

## FIG.1

100 TEST APPARATUS  
101 PROTOCOL PROCESSING SECTION  
104 LAYER 1 TRANSMISSION SECTION  
5 105 LAYER 1 RECEPTION SECTION  
106 MEASUREMENT SIGNAL GENERATING SECTION  
108 MEASUREMENT SIGNAL JUDGING SECTION  
109 MOBILE TERMINAL RLC CONTROL SECTION  
110 CONTROL SECTION  
10 TEST ITEM INSTRUCTING SIGNAL  
150 MOBILE TERMINAL APPARATUS  
151 PROTOCOL PROCESSING SECTION  
154 LAYER 1 TRANSMISSION SECTION  
155 LAYER 1 RECEPTION SECTION  
15 156 LOOPBACK SECTION  
158 EXTERNAL INTERFACE  
159 CONTROL SECTION  
TO EACH SECTION  
200 TRANSMISSION POWER MEASURING APPARATUS

20

## FIG.2

100 TEST APPARATUS  
101 PROTOCOL PROCESSING SECTION  
104 LAYER 1 TRANSMISSION SECTION  
25 105 LAYER 1 RECEPTION SECTION  
106 MEASUREMENT SIGNAL GENERATING SECTION  
108 MEASUREMENT SIGNAL JUDGING SECTION



109 MOBILE TERMINAL RLC CONTROL SECTION  
110 CONTROL SECTION  
TEST ITEM INSTRUCTING SIGNAL  
150 MOBILE TERMINAL APPARATUS  
5 151 PROTOCOL PROCESSING SECTION  
154 LAYER 1 TRANSMISSION SECTION  
155 LAYER 1 RECEPTION SECTION  
156 LOOPBACK SECTION  
158 EXTERNAL INTERFACE  
10 159 CONTROL SECTION  
TO EACH SECTION  
200 TRANSMISSION POWER MEASURING APPARATUS  
160 OPERATION SECTION  
300 EXTERNAL CONTROL APPARATUS  
15 FIG.3  
MOBILE TERMINAL  
TEST APPARATUS  
UNDER TEST